Modern Concepts of Cardiovascular Disease

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OBESITY AND HEART DISEASE—A PERENNIAL PROBLEM*

Like death and taxes, the obese are always with us. Even though references to obesity may be found as far back as the early Hindu, Chinese, Greek and other ancient writings, no successful simple solution to this problem has been found to date.

Factual data are available to point out that obesity is a hazard in modern life. Sustained hypertension develops in the obese at a rate twice as fast as in the normal weight group. The insurance company statistics demonstrate very clearly that overweight men and women in every age group have a higher mortality rate than normal weight groups. The degenerative diseases of the heart, blood vessels and kidneys, usually grouped together as the cardiovascular-renal diseases, are responsible for most of this increased mortality. One immediately raises the question—why? There is no simple answer available. Many theories have been advanced and these will be discussed in a future report. Is this vascular degeneration due to the foods consumed? Is it due to the extra work load put on the cardiovascular system over a long period of time? It can be shown (Table I) that the caloric requirements in obesity are much greater than in persons of normal weight. This extra work load is in part responsible for some of the effects.

Obesity is due to an intake of calories in excess of metabolic demands, a fact which has universal acceptance. An analysis of this statement reveals two variables: (a) the intake of calories, and (b) the metabolic demands. The mathematical and physiological relationships of one to the other of these two basic factors are very close and complex. As calorie intake increases, metabolic demands increase. As calorie intake decreases, metabolic demands decrease. A constant body weight at any level is indicative that the two variables have reached a steady state with respect to each other. Every increment of increase in body weight requires an increment of increase in caloric intake to maintain it (Table I). An obese individual must eat more merely to maintain his obesity.

TABLE I

Ratio of Body Weight to Caloric Requirements

Thirty-Five-Year-Old Man

Height	Weight (Pounds)	Basal Calories in 24 Hours
5′10″	100	1470
	125	1600
	150	1730
	175	1840
	200	1970
	225	2060
	250	2180

Thirty-Five-Year-Old Woman

Height	Weight (Pounds)	Basal Calories in 24 Hours
5′2″	90	1180
	100	1240
	125	1360
	150	1470
	175	1580
	200	1680

Table I refers to basal calories, but obesity also has a very definite effect on work calories. In some recent experiments we determined that a 150-pound, 5-foot, 10-inch man expended 100 calories (98.8 calories to be exact) while walking a mile on the level ground. When a 22-pound weight was put on his shoulders, the calorie expenditure rose to 109 calories for each mile. The addition of another 22 pounds on top of the first sent the calorie expenditure to 120 calories for the mile. A further increment of 22 pounds forced the calorie requirements to 132 calories, and the next increment of 22 pounds, making a total of 88 pounds, called forth the expenditure of 142 calories in covering the mile. This latter figure is equivalent to a man weighing 238 pounds. Such a man will walk an average of five miles a day just around the house

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and office; most men will walk more, a few less. Multiplying 5 for the average miles by 42 for the increased calories for each mile, the answer is 210 calories a day extra in mere routine movements. To this one can add the approximate 400 calories a day in basal requirement increase, giving a total of 600 calories a day more than a 150-pound man. The 600 calories can be expressed in terms of the food required to supply them and the oxygen necessary for the metabolism of the food. Interpreting this into food, the obese man eats the equivalent of one dinner a day extra in addition to the average three meals a day. In terms of specific foods, this is equal to 10 standard slices of bread, ¾ dozen eggs, or 7 pats of butter. If the man walks more, such as a mail carrier, policeman, messenger. etc., the difference is magnified many times. The obese individual may consider maintaining a constant weight his normal eating pattern. Frequently, when an attempt is made to teach him that his normal eating pattern is that which will maintain his optimum weight, he fails to understand and considers it restricted eating.

One can calculate the amount of oxygen required for this 600-calorie increment. Each 4.8 calories requires one litre of oxygen for the conversion of the food to kinetic energy and heat. For 600 calories, this is 120 litres of oxygen. Each respiration under normal conditions supplies only about 25 ml. of oxygen to the blood. This means that 4800 extra respirations a day are required to supply the 120 litres. Under conditions of high physical output the efficiency of the transfer system decreases and the respiration rate goes up even further. The very obese, while resting, have a respiratory rate of three breaths more a minute, on the average, than the nonobese. With exercise and work the appearance of dyspnea is manifest. The pulse rate increases with the respiratory rate under these circumstances and increases the cardiac output. In the presence of actual heart disease, where every effort is made to relieve the burden on the cardiorespiratory system, it becomes very evident that weight reduction and decreased metabolic demands are of extreme importance in achieving this end result. Obesity, as important as it is over a long period of time in the development of cardiovascular-renal disease, also has an immediate effect on cardiac decompensation and on asymptomatic cardiac disease with limited reserve.

This simple arithmetical approach to the problem of obesity is unfortunately not too practical as it fails to account for the "appetite" factor. Anyone can lose weight by curtailing his caloric intake. The component missing in this explanation is the *motivation* for increased appetite, or the *motivation* to achieve an optimum weight and maintain it. People of average intelligence in all societies can learn to change their ways of living and will do so if it can be demonstrated that the new way of life will serve their own interests.

Serious emotional problems may be important as contributory factors, but fortunately most of the obesity encountered in daily practice is due to other causes. It is due to carelessness and ignorance of certain basic facts. As a rule, the average overweight individual does not eat more or richer food that he did in the past when he was slim. As he or she grows older two basic factors change, i.e., the metabolism decreases and there is some slowing down in physical activity.

We are accustomed to think in terms of basal metabolic rates. By definition this is a comparison of the individual's metabolism with the average metabolism for the same age, sex, height and weight. The basal metabolic rate does not change with age as this is a comparative figure, but the absolute requirements decrease about 7 per cent for each decade of life in all people (Table II).

TABLE II

Relationship of Age to Caloric Requirements

Sex	Height	Weight (Pounds)	Age	Basal Calories 24 Hours
Male	5′10″	150	14-15	2020
			16-17	1890
			18-19	1800
			20-29	1730
			30-39	1730
			40-49	1690
			50-59	1650
			60-69	1600
			70-79	1560
Female	5′2″	125	14-15	1600
			16-17	1490
			18-19	1410
			20-29	1370
			30-39	1360
			40-49	1340
			50-59	1300
			60-69	1260
			70-79	1230

In addition to the fact that physiological requirements and activity decrease with age, there is an additional mechanical factor in modern living which tends to lessen requirements. The energy in gasoline and electricity replaces the energy in food in transporting an individual. A man used to walk to his place of business. Today he rides, but his food intake may remain the same. It was pointed out that the average man expends about 100 calories in walking a mile. In the course of time these miles can add up to a great many calories. The farmer who once walked behind the plow for many hours a day at 400 calories an hour, now rides his tractor at 130 calories per hour. The housewife who used to wash clothes or scrub floors at 250 calories every hour, now uses the washing machine, vacuum cleaner, or floor polisher at 120 calories per hour.

Obesity developing in people over 30 years

of age is usually a slow process. The individual may gain only a few pounds a year, but it is accumulative. At the end of 10 to 20 years there is a rude awakening to this situation and the sudden recognition of 10 to 40 pounds in excess weight.

It is simple enough to gain weight by small increments. The converse is true also; one can lose weight successfully by small increments. The basis for this concept may be explained by some very simple arithmetic. A pound of body weight is equal to approximately 3500 calories. One hundred calories a day for 365 days of the year add up to 36,500 calories. In terms of body weight this is approximately 10 pounds. An average pat of butter contains 85 calories, and a slice and a half of bread about 100 calories. By simple calculation one sees that one extra pat of butter a day over and above metabolic requirements will lead to a theoretical gain of over 8 pounds a year. A piece of pie, averaging 250 calories, just once a week, in the course of the year adds up to 13,000 calories a year, or the equivalent of more than three pounds of body weight.

The converse of small increments of energy expenditure works the same way. A 150-pound man in heavy clothing spends 100 calories to walk one mile. A smaller person spends proportionately less and a heavier person proportionately more. If the food intake and past daily activity are kept constant, the superimposition of walking will increase the caloric expenditure and result in a measurable calculated weight loss. The practical solution to the problem of the weight gain in adult life is the combination of a decrease in calorie intake with an increase in calorie output. This is not to infer that one must indulge in violent calisthenics, mountain climbing, tennis or other activities where the rate of calorie expenditure by the hour is doubled or tripled. Far from it. Such violent exercise in older people puts a great strain on the cardiovascular-respiratory system. Nor is there any point in taking a brisk walk which will stimulate the appetite and result in a net gain in calories rather than a deficit. What is implied is that people should be instructed to walk rather than ride to nearby places. Walk in a leisurely fashion without placing sudden demands on the circulation. The calorie cost of a mile is essentially the same whether you walk it in 10 minutes or 30 minutes, but the effect on the circulation is quite different. Most cardiac patients not in failure can increase their work load up to 250 calories an hour for periods of time without strain. This means walking at the rate of two miles per hour with adequate rest periods.

Decreasing calorie intake does not call for drastic starvation diets. In people under 40 the elimination of between-meal foods by itself will accomplish a great deal. Avoiding oily salad dressings, and food cooked in fats will result in an appreciably decreased calorie intake.

A word of caution is indicated concerning the various fad and pseudoscientific diets proposed frequently to aid weight reduction. No diet that violates the law of conservation of energy can succeed in a weight-reducing program. Any diet prescribed for a patient must be nutritionally adequate. The nutrient and micronutrient demands are greater in the obese than in individuals of optimum weight because of their higher metabolic expenditures. A diet that proposes to limit or eliminate any major category of food stuffs except certain "empty calories," such as highly refined foods, will not supply adequate nutrition.

The patient with cardiac disease at one time or another, for longer or shorter periods, may be restricted in his physical activities. This is a predisposing factor in the development of obesity if attention is not given to the dietary intake. The control of the diet of the cardiac patient is especially important from many points of view.

Anorexia is not an uncommon complaint in patients with cardiac decompensation or during digitalis administration. This must be combated as vigorously as hyperalimentation during the period of convalescence. Restoration of muscle strength, be it cardiac or voluntary striated, is dependent on good nutrition. One must not forget that hypoproteinemia resulting from malnutrition is not uncommonly a contributing factor in the development of edema in the cardiac patient.

The complicating factor of sodium restriction for the patient with congestive failure or hypertension makes the problem doubly difficult. Patient discussion of food habits, likes and dislikes, when coupled with a knowledge of the dietary factors and an appreciation of the physiology, can lead to a happy solution of the individual's problems. This will help to avoid chronic invalidism, speed recovery, and even prevent or delay complications.

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The opinions and conclusions expressed herein are those of the author and do not necessarily represent the official views of the Scientific Council of the American Heart Association.

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